Aus dem Institut für Unfallmedizin
(Vorsteher: Prof. Dr. H. Nigst)
und der Poliklinik der Chirurgischen Universitätsklinik Basel
(Vorsteher: Prof. Dr. R. Nissen)

Results of Skin Grafts on Fingertip Defects
An Analysis of 156 Cases

Inaugural-Dissertation
zur Erlangung der Doktorwürde der Medizinischen Fakultät
der Universität Basel

vorgelegt von
LEONARD DEUTSCH
von New York, USA

1963

Basel 1963
Druck: Buchdruckerei National-Zeitung AG

Aus dem Institut für Unfallmedizin
(Vorsteher: Prof. Dr. H. Nigst)
und der Poliklinik der Chirurgischen Universitätsklinik Basel
(Vorsteher: Prof. Dr. R. Nissen)

Results of Skin Grafts on Fingertip Defects
An Analysis of 156 Cases

Inaugural-Dissertation
zur Erlangung der Doktorwürde der Medizinischen Fakultät
der Universität Basel

vorgelegt von
LEONARD DEUTSCH
von New York, USA

Basel 1963
Druck: Buchdruckerei National-Zeitung AG

Von der Medizinischen Fakultät genehmigt auf Antrag von
Prof. Dr. H. Nigst

Tag der Promotion: 28. Januar 1963

A cette occasion, je remercie sincèrement M. le Professeur Nigst, qui par son aide et conseils anima ce travail

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41546021_0066

To my Parents

A total of 595 patients underwent surgical procedures for the repair of fingertip trauma during the 5 year period 1953–1957 in the outpatient department of The City Hospital of Basle. These 595 patients represent 3,5% of the total number of 16,889 operations performed in the same period for all various reasons in the emergency room of the outpatient department of The City Hospital, Basle.

	Amputation	Operative amputation	Total amputations	Total grafts	Total procedures
1953	33	23	56	24	83
1954	20	64	84	29	125
1955	11	42	53	63	115
1956	4	46	50	89	138
1957	16	37	53	69	134
	84	212	296	274	595 *

As seen above a total of 296 patients underwent traumatic amputation or operative amputation of one or more fingertips (or fingers) during this 5 year period. In that same time 274 patients underwent grafting operations (Thiersch, Wolfe-Krause, Reverdin or Crossfinger) on one or more fingertips. These are the only types of fingertip skin grafts which we will consider in this paper. Of these 274 patients we were personally able to see 136 for a check-up examination $^1/_2$–$5^1/_2$ years after the completion of the operation. These 136 patients represent 156 skin grafts, since some patients had more than one fingertip skin graft.

Only these 136 patients will be considered in this report.

108 of them were further investigated in the files of SUVA (Swiss Accident Insurance Institute) to gain additional data as to the duration of the period in which the patient was unable to work and the cost of treatment.

It is now generally agreed that the frequency of the problem of covering a skin defect due to trauma of the finger, particularly of the end phalanges, is in itself one of the strongest arguments for its consideration.

In Workmen's Compensation Insurance by far the largest number of injuries, and the greatest expense, are incurred from hands. Of all indus-

* The discrepancy seen in the sum of the figures for total amputations plus total grafts compared to the figure for total procedures is explained by the fact that some patients underwent procedures other than amputations or grafts, e.g. pedicle grafts which, except for Crossfinger grafts, are not considered in this paper. Furthermore, an amputation and a graft performed on different fingers of the same patient were counted as one procedure.

trial accidents those of wrists, hands and digits amount to over $^1/_3$ in number and about $^1/_5$ of the cost. Statistics vary according to industries, in some reaching to as high as over one half in the number of hand injuries. Of 142,715 accidents in California in 1953, 12% were of one or more fingers on one or both hands (10).

Bunnell further quotes statistics stating that the Oregon State Industrial Accident Commission reported for the first half of 1942 that of 26,673 cases the most common injury was of the eye (5,944 cases) then came hands and fingers (4,863 cases), then fingers alone (3,377 cases or 13%).

Bunnell also quotes *Iselin* in stating that the French State Railway paid 46% of its total compensation for injuries to hands. In addition, he goes on to state that in California in 1915 of 1,264 cases of total disability, 40 were cases involving hands and 750 were cases of digits, totaling 790 cases or 62% of all. He estimates that the ratio of temporary to those of permanent disability in hands is 9:1 and non-disabling injuries about 80 times as common as the disabling injuries.

He points out that about 1 in 10 of all injuries become infected, but of all hand injuries the ratio increases to 1 in 4. And of all infected cases 49% are of digits.

The average compensation expense of a hand injury according to a New York State statistic of 1932 was $ 93.– but it was $ 188.– (or double) if the wound became infected.

In 1926 the Travelers Insurance Co. showed that for every accident there are hidden expenses for replacement of machinery, break in continuity of work, etc., that amounts to 4 times the expenses of the resulting injury to persons (10).

From the point of view of the patient the loss of a fingertip can mean, and often does mean, a certain duration of unemployment due to his disability. On the other hand the surgeon carrying out the procedure for repair has a choice of several methods of covering the skin defect. Therein may lie the possibility of influencing immediate factors such as the duration of unemployment resulting from the injury, cost of treatment, and inconvenience to the patient, as well as the long range factor of the degree of usefulness which the finger will later serve. It should of course be borne in mind that one must not lose sight of the problem as a whole. Each one of the factors just mentioned (duration of unemployment, cost of treatment, utility of the stump, as well as the cosmetic factor) will be of different importance, depending on the individual patient involved. And generally the patient relies completely on the judgment of the surgeon. It is, therefore, important for the surgeon to be aware of the influence he may have on some or all of these factors by the method he chooses to undertake in repairing the injury.

The types of grafts considered here are Wolfe-Krause, Thiersch, Reverdin and Crossfinger. The first three fall into the category of free skin grafts, whereas the Crossfinger belongs to the flap type of graft.

The 156 grafts with which we are herein concerned are broken down as follows:

92 Thiersch
28 Crossfinger
28 Wolfe-Krause
8 Reverdin

As *Bunnell* points out the advantage of free skin grafts is that in contrast to pedicle grafts they can be applied in one operation, saving weeks of hospitalization and the inconvenience of step operations and attachment of the pedicle graft (10). Briefly, the Wolfe-Krause is a full-thickness graft in which the subcutaneous fat tissue is dissected away before the graft is fixed in place. The method is less delicate than the Thiersch and, therefore, lends itself more readily to use during office hours, although because of shrinkage the graft has to be cut about $^1/_3$ larger than the defect it is meant to cover (11).

The Thiersch method, or split-thickness graft, requires more manual dexterity in order to prepare a graft consisting of the epithelial and papillary layers of the cutis.

The Reverdin, or Island Graft, is the simplest to carry out technically. It basically consists in the preparation of many round pieces of skin cut until the papillary layer. The individual pieces are cut about $^1/_2$ cm in diameter, the number of pieces being determined by the size of the defect to be covered. The Crossfinger flap consists of skin and subcutaneous tissue from that finger adjacent to the injured area.

The chief indication for the Crossfinger flap is for the coverage of structures not suitable for repair with free skin grafts. Such structures are: tendons, bones, joints, and sometimes nerves. In addition, deep losses of pulp and amputation stumps are ideal for repair by this method. The Wolfe-Krause graft may sometimes be unsatisfactory due to lack of padding and adherence of the grafts to the bone (1).

Kilbourne points out that fingertip amputations present a site to which, because of the relatively small area of exposed bone and the larger fat pad, a small split graft can be applied with good results (3). Healing is prompt and the length is saved.

Bruck stresses the advantages of the Wolfe-Krause graft, especially as compared to the Reverdin. He claims that the Reverdin is to be excluded from use in fingertip repair because its uneven surface laced with scar tissue is cosmetically inferior and must be functionally disadvantageous. On the other hand the Wolfe-Krause and Thiersch grafts offer cosmetically and functionally the best possible method of repair (4).

Ostapowicz, on the other hand, points out that the necrosis of parts of the graft in the Reverdin method does not endanger the survival of the graft as a whole, and that this fact should not be lost sight of (7).

May reminds us that with the advent of antibiotics a greater overall success in the take of grafts has come about (8, 9). Consequently it should

be expected that *Bunnell's* argument to use the greatest thickness that will take on an injured site has undergone a certain degree of promotion, so that what previously was too thick a graft may, in some cases at least, no longer be so, and a thicker graft than previously used, can in those cases be expected to meet with success.

According to *Ballinger* (2) we have the following possibilities when considering fingertip repair. The comments are also his:

1. Per secundam healing (this is for obvious reasons completely negative).
2. Adjacent tissue skin flaps (this can only rarely be accomplished without further bone amputation).
3. Free graft (Thiersch) covering is too thin. If full thickness is used it generally does not take.
4. Immediate one stage pedicle graft from a distant site.
5. Immediate pedicle graft from palm. Method of choice. Full thickness pedicle flap is used. Sutures are cut during the second week. The graft is detached at the end of the third week.

Boehler (5) breaks the choices down as follows:

1. Per secundam healing.
2. Shortening of the finger so as to be able to cover the defect with skin.
3. Plastic coverings which are subdivided into:
   a) flaps,
   b) free grafts.

However one wants to look at it, the per secundam healing of a fingertip injury is undesirable if only because of the increased length of time for healing which is required, as well as the increased danger of a scar, resulting in a hampering of the function.

The shortening of the finger, so as to be able to provide a skin covering for the injured fingertip may sometimes be the best method, especially if the injured person is an old patient (5), where there is a real danger of the stiffening of the finger.

However, thumb injuries present an especially serious problem, so that in every case a fingertip plastic is worth trying in an effort to save whatever possible, since here every millimeter is of importance (6).

Bunnell points out that, in questionable beds, grafts of partial thickness are more apt to take than those of full thickness. The more questionable the vascularity and asepsis of the bed the thinner should be the graft. Thicker split grafts give a better quality of the skin than thin ones do, because they contain more skin structures. Thiersch grafts do not furnish all the necessary structures to grow into good skin as they include very little of hair follicles, sweat, sebaceous glands and fat.

Bunnell suggests that – in order to obtain the best quality of skin – we should select the greatest thickness of skin which will survive in that area. Thin skin, or Thiersch grafts, will grow even on granulating surfaces where thicker grafts usually fail (10). The thinner the graft the greater the contracture; however, the healing time will be shorter.

Thin or Thiersch grafts are useful to close in quickly raw granulating areas, immediate wounds and places from which skin flaps have been swung (13). The advantages of this are obvious. By closing in raw areas with grafts, infection is terminated, and we avoid the too luxuriant growth of granulations which later lead to contracture. In discussing full thickness grafts (Wolfe-Krause) *Bunnell* points out that they will scarcely grow over tendons, bones, or joint ligaments; nor will they grow if there is gross infection present, such as is always found in granulating tissue. The full thickness graft requires a vascular aseptic bed and a longer time to heal than the split thickness graft. Full thickness grafts furnish a better quality of skin. The most frequent complications occuring in the use of these free grafts are:

1. Necrosis of graft.
2. Hematoma of donor area.
3. Keloid in those susceptible.

Bunnell reports having seen a case of carcinoma which developed in the donor area (10).

The most frequent complaints encountered by the patients considered in this paper were as follows:

	Thiersch	Wolfe-Krause	Crossfinger	Reverdin
Rhagades and opening of the graft, with and without bleeding	15 (16%)	2 (7%)	5 (17%)	2 (33%)
Nail disturbances	10 (11%)	5 (18%)	6 (21%)	2 (33%)
Paraesthesia	13 (14%)	10 (36%)	4 (14%)	2 (33%)
Hypaesthesia*	5 (5%)	–	4 (14%)	–
Hyperaesthesia	2 (2%)	2 (7%)	–	–
Feeling of tension	5 (5%)	3 (11%)	2 (7%)	–
Hyperplasia	1 (1%)	1 (4%)	4 (14%)	–

* The complaint of Hypaesthesia at the site of the graft was subjective and was verified objectively in 4 of the 5 Thiersch cases as well as 4 of the cases with a crossfinger graft (see chart 6 Sensitivity to Touch).

In judging the success* of the "take" of the grafts, we made the following observations:

Chart 1a

	Success	Partial take	Failure
Thiersch	84 (91%)	5 (5%)	3 (3%)
Wolfe-Krause	24 (86%)	2 (7%)	2 (7%)
Crossfinger	27 (93%)	1 (3%)	1 (3%)**
Reverdin	7 (87½%)	1 (12½%)	–

This favourably compares with *Baur* (15) who reports the following figures for the success of finger grafts in the primary treatment of finger injuries:

Chart 1b

	Success	Partial take	Failure
Thiersch	18 (55%)	10 (30%)	5 (15%)
Wolfe-Krause	41 (67%)	11 (18%)	9 (15%)
Crossfinger	4 (100%)	–	–
Reverdin	1 (33%)	1 (33%)	1 (33%)

These last figures, however, are those from an insurance company with very many different operators. The results from the outpatient department of the Basle Clinic give a much better impression of the value of the different methods, although here too several surgeons – senior and junior residents – are involved. Still better results can of course be reached by a single experienced surgeon and such a series would, so to say, give the absolute value of the method.

The disadvantages of free skin grafts, in general, are that they need a good vascular bed. The scars remaining after infection are not suitable. They are devoid of subcutaneous tissue and are not so durable as normal skin is in parts which receive wear (10). Tendons will not glide under them. They shrink, especially if thin, and often pigment.

* Successful take from the first time the graft was applied.

** In 1 case the graft did not take and the operation had to be followed by a second operation for amputation of the finger. Because of the amputation of this finger this Crossfinger graft could not be considered in all of our calculations.

Bunnell states: "Free skin grafts are suitable for shallow, superficial cicatrixes such as those from burns, but are less so over the cicatrixes from infections which were produced from within" (10).

Padgett (13) describes the following thicknesses given in inches for the various free skin grafts:

.008–.010	Thiersch
.012–.020	Superficial intermediary $^1/_3$ to $^2/_3$ of full thickness.
.022–.030	Deep intermediary 75%–95% thickness.
.032–.045	Full thickness 100% (if too deep may take all skin elements).
.010–.012	Not over this in baby.
.014–.016	This may be too deep for a child of 6.
.016–.018	Not over this in child of 12–14.
.018–.020	May be deep in woman with abdomen streched in pregnancy or on inner side of thigh or arm.

As seen in chart 2 the fingers of the right hand were involved in 63 transplantations and those of the left in 93, or about 50 % more.

Taking left and right fingers together:

The thumbs were involved	in 35 or 22 %
The index fingers	in 39 or 25 %
The middle fingers	in 44 or 28 %
The ring fingers	in 22 or 14 %
The fifth fingers	in 16 or 11 %

Of the 35 thumbs involved, a	Thiersch	was done on 19
	Crossfinger	on 11
	Wolfe-Krause	on 4
	Reverdin	on 1

Of the 39 index fingers, there were	23	Thiersch
	9	Crossfinger
	7	Wolfe-Krause

Of the 44 middle fingers, there were	28	Thiersch
	3	Crossfinger
	8	Wolfe-Krause
	5	Reverdin

Of the 22 ring fingers, there were	12	Thiersch
	4	Crossfinger
	6	Wolfe-Krause

Of the 16 fifth fingers, there were	10 Thiersch
	1 Crossfinger
	3 Wolfe-Krause
	2 Reverdin
For a total of	92 Thiersch
	28 Crossfinger
	28 Wolfe-Krause
	8 Reverdin

during a 5-year period.

Chart 2

Left hand

Finger	1st	2nd	3rd	4th	5th	
Thiersch	14	11	14	10	7	= 56
Crossfinger	9	5	1	2	1	= 18
Wolfe-Krause	3	3	4	2	2	= 14
Reverdin	–	–	3	–	2	= 5
	26	19	22	14	12	

Right hand

Finger	1st	2nd	3rd	4th	5th	
Thiersch	5	12	14	2	3	= 36
Crossfinger	2	4	2	2	–	= 10
Wolfe-Krause	1	4	4	4	1	= 14
Reverdin	1	–	2	–	–	= 3
	9	20	22	8	4	

Lost Work Days

In 108 cases where the number of lost work days could be determined accurately, we made the following findings:

As seen in Chart 3 the Thiersch transplants had an average of 37.4 days for 58 cases, which is significantly lower than the averages of all 3 other groups.

This is about 23 % (11.6 days) less than the next closest group (Wolfe-Krause) which had an average duration of 49 days, 13.6 days or 27 % less than the Crossfinger, which had a 51 day average, and 31 % or 17.1 days less than the Reverdin.

Chart 3

Lost Work Days

	Thiersch		Crossfinger		Wolfe-Krause		Reverdin	
1953	(–)		(–)		(3)*	49	(4)	74
1954	(1)	23	(5)	51	(–)		(–)	
1955	(20)	31.9	(9)	50	(1)	75	(1)	22
1956	(26)	44	(9)	48	(2)	61	(2)	32
1957	(11)	32.8	(2)	69.5	(12)	44.75	(–)	
	(58)	37.4	(25)	51	(18)	49	(7)	54.5

Riess (6) reports for an average of 25 cases a loss of work of less than 6 weeks for the Thiersch graft.

Bruck (4) reported on 28 cases. Of these, 21 cases were of a Thiersch graft treated with Isomycin Atorykain (local anaesthetic-antibiotic). 18 were returned to work after 14 days. 2 needed an additional 4–6 days, and in 1 case the graft did not take due to lack of co-operation on the part of the patient. Of the remaining 7 cases, 2 were Thiersch grafts which were not treated with Isomycin and required 10 days longer in healing. 3 were full thickness grafts with Isomycin. Of these, 2 healed well as in the Thiersch without Isomycin, and 1 was a failure due to lack of co-operation on the part of the patient. Finally 2 totally untreated cases needed not less than 5 weeks to heal.

Baur (12) in reporting on the average number of work days lost for 9 Thiersch, 36 Wolfe-Krause and 3 Reverdin grafts found the following averages:

Thiersch	48.5 days
Wolfe-Krause	43.3 days
Reverdin	45 days

Duration of Treatment

Chart 4

	Thiersch		Crossfinger		Wolfe-Krause		Reverdin	
1953	(–)		(–)		(3)*	84	(4)	149
1954	(1)	45	(5)	68	(–)		(–)	
1955	(20)	44.4	(9)	62	(1)	81	(1)	28
1956	(26)	63	(9)	60	(2)	76	(2)	46
1957	(11)	45.8	(2)	44.5	(12)	57	(–)	
	(58)	53	(25)	61	(18)	65	(7)	102

* Numbers in brackets refer to the number of cases.

Baur (12) found an average duration of treatment for 9 Thiersch cases of 68.8 days. For 36 Wolfe-Krause patients he noted an average of 55.8 days and for 3 cases of Reverdin an average of 50.3 days.

As seen in the following chart; according to the available records of 48 patients who underwent a Thiersch transplantation, the average cost of treatment was SFr. 162.– compared with:

SFr. 177.– for 6 Wolfe-Krause grafts,
SFr. 198.– for 6 Reverdin grafts and
SFr. 235.– for 21 Crossfinger grafts.

Chart 5

Average Cost of Treatment

	Thiersch	Crossfinger	Wolfe-Krause	Reverdin
1953	–	–	(2)* 199	(3) 292
1954	(1) 119	(5) 261	–	–
1955	(17) 133	(5) 247	–	(1) 94
1956	(25) 184	(9) 231	(1) 219	(2) 110
1957	(5) 163	(2) 205	(3) 149	–
	(48) 162	(21) 235	(6) 177	(6) 198

Sensitivity to Touch

The results of testing the healed fingergraft for sensitivity to touch with a ball of cotton were, as seen in Chart 6: Thiersch grafts showed favorable results in 65 cases, satisfactory results in 11 cases and unsatisfactory results in 4 cases.

The donor finger of 29** Crossfinger grafts gave favorable results in 24 cases, the injured finger gave favorable results in 23 grafts. The results were unsatisfactory in the donor finger of 5 cases and in the injured finger of 5 Crossfinger grafts. It should be noted that the cases that gave unfavorable results in the donor finger in all 5 cases were the same as those that gave unfavorable results in the injured finger.

Of 26 successful Wolfe-Krause grafts tested for sensitivity, very good results were obtained in 18 cases, good results in 8 cases, and in no case was the test for sensitivity unsatisfactory.

The results were very good in 6 of the 8 cases where the Reverdin graft was tested and in 2 cases the results were satisfactory. In no case was there an unsatisfactory result.

* The numbers in brackets refer to the number of cases.

** In 1 case the graft did not take and the operation had to be followed by a second operation for amputation of the finger.

Chart 6

Sensitivity to Touch

	++	+	—
Thiersch	65	11	4
Wolfe-Krause	18	8	0
Reverdin	6	2	0
Crossfinger			
Donor finger	24*		5
Injured finger	23		5

Complaints of Pain

Of the patients who underwent an operation for a Thiersch graft, 62 (78%) were free of pain and 17 felt occasional pain on the site of the graft.

Those patients with a Crossfinger graft showed a slightly higher percentage who complained of pain on the site of the graft or donor finger. Although these patients' complaints are purely subjective, they gave the impression that the pain was more intense than in the other types of grafts, and that the pain they complained of also occurred more frequently than in patients with all other types of grafts. Of 28 cases, 20 (71%) were free of pain, and 8 complained of pain. One complained of pain only in

Chart 7

Complaints of Pain

	+	—
Thiersch	17	62 (78%)
Wolfe-Krause	11	17 (61%)
Reverdin	2	6 (75%)
Crossfinger		
Donor finger	7	21* (75%)
Injured finger	7	21 (75%)

* See preceding text.

** Although 21 patients were free of pain in the donor finger, and 21 were free of pain in the injured finger, 1 patient complained of pain in the donor finger only and another patient complained of pain in the injured finger only, so that only 20 patients (71%) were free of pain in both, the donor finger and the injured finger.

the injured finger (i.e. site of the graft), and one complained of pain only in the donor finger, while 6 complained of pain in both fingers. 17 patients (61 %) with a Wolfe-Krause graft were free of any distress from pain and 11 complained of slight pain occasionally. The patients with Reverdin grafts were free of pain in 6 (75 %) cases and complained of occasional pain in 2 cases.

Sensitivity to Cold

35 Thiersch grafts (38 %) showed sensitivity to the cold without pain, 22 grafts (24 %) showed sensitivity with pain and 35 (38 %) showed no sensitivity to cold. The Crossfinger grafts showed a higher percentage reacting to cold.

Of the Crossfinger grafts: 10 grafts (36 %) and 7 donor fingers (25 %) were sensitive to the cold but not painful, the sites of 14 grafts (50 %) and of 12 donor fingers (43 %) reacted with pain; 4 grafts (14 %) and 9 donor fingers (32 %) were not sensitive to cold.

The distribution of the individual reactions shows that in 8 cases (20 %) both the donor site and site of the graft in the same patient reacted painfully to the stimulus of cold weather. Of the remaining 6 cases (21 %) where the graft reacted with pain; in 3 cases the donor site was not sensitive to the cold, and in 3 cases it was sensitive, but not painful. Of the 4 cases where the donor site reacted with pain but the graft did not react with pain, the graft was in all 4 cases sensitive to the cold.

In the 7 cases where the donor was sensitive but not painful to cold, the site of the graft was in 4 cases also sensitive but not painful, and in 3 cases painful.

Of the 10 cases where the site of the graft was sensitive but not painful, the donor site was sensitive but not painful in 4 cases, painful in 4 cases and insensitive in 2 cases.

Of the 4 cases where the graft site reacted insensitive to cold, the donor finger also reacted insensitive. Of the 9 cases where the donor site reacted insensitive to cold, the graft site was insensitive in 4 cases, sensitive but not painful in 2 cases and painful in 3 cases.

Of the Wolfe-Krause grafts, 11 reacted painfully to the cold, 14 were sensitive to the cold but not painful, and 3 were not sensitive.

The Reverdin grafts showed the following distribution: 2 sensitive but not painful, 3 painful and 3 insensitive.

Conclusion

Keeping in mind the fact that the operations reviewed in this paper were not performed by any one surgeon, but on the contrary, by a number of surgeons, we feel justified in maintaining that it is perfectly reasonable to expect that if such a series of operational procedures were to have been carried out by only one skillful surgeon, the results would then produce a shift in the statistics to show an even more favorable picture regarding

the success of the grafts. Such a series would give a much more accurate indication of the absolute value of the methods considered. The closer the surgeon approaches a theoretical point of perfection, the more accurate would be such an absolute value. The limitations of the method could then be much more exactly defined. Nevertheless, the very high percentage of successful takes found in our series speaks clearly in favor of the use of these grafts in the repair of fingertip injuries. When reviewing the overall success of the various grafting methods it is important to be aware that the Crossfinger grafts (which, as a group, showed the highest percentage of successful takes) were used in cases which were not exactly comparable to the cases in which the various free skin grafts were employed. That is to say, that in certain cases a free graft was by necessity ruled out right from the start, e.g. due to a need for padding over bone.

Hence, we see that for the group of Crossfinger grafts the injury to the finger was on the average considerably more severe than in those cases where a free skin graft was applied.

In the latter group of cases the injury was generally limited to soft tissues, and often was little more than solely a skin defect that had to be covered, the deeper structures remaining uninjured; whereas in those cases receiving a Crossfinger graft the injury went deeper and was of a more serious nature.

Consequently the information, derived from the tests for sensitivity (Chart 6) could be misinterpreted to the disadvantage of the Crossfinger graft. The same is true in interpreting the figures given for the average number of lost work days (Chart 3), average duration of treatment (Chart 4) and average cost of treatment (Chart 5). On the other hand the good results seen in the high percentage of grafts that succeeded in "taking" (Chart 1) support the view of *Baur* (12) who maintains that for all practical purposes the frequency of success of the take of the Crossfinger graft can be reckoned at 100%. Therefore, in consideration of the greater severity of the injury being treated in those cases where the Crossfinger grafts were applied, we believe that the Crossfinger graft compares favorably with the overall results obtained by use of the free skin grafts, and that this is especially so when considering the question of whether the graft will successfully take.

The Thiersch skin graft can be expected to give adequate coverage, especially in those cases where a padding is not required, i.e. when it is not to be placed immediately over bone.

The percentage of Thiersch grafts which successfully took was extremely high (91%), and indeed was second only to the Crossfinger grafts which had a fully successful take in 93% of the cases, a difference which in the framework of this series cannot be considered significant.

Other authors, however, claim a still higher percentage of success for the Crossfinger graft, and a lower percentage for the Thiersch graft. The 86% successful "takes" found with the Wolfe-Krause grafts rank not very far below the Thiersch grafts (91%) in this respect. As previously mentioned the quality of the skin is better than that of the Thiersch. The

results found in dealing with the Reverdin "Island Graft" were such as to lead us to believe that it is a valuable aid in the covering of skin defects in selected cases. The degree of success with which it can be expected to take is probably a respectable figure. As seen in Chart 1, 87.5% of these grafts took successfully. However, this figure is based on the observation of only 8 cases and, by far, cannot be considered as conclusive. In spite of this, there seems to be little doubt that in certain cases the advantage of being able to divide the source of the skin graft over various parts of the body may be of substantial importance and a decisive factor, in the surgeon's decision to opt for employing this graft. In addition, the Reverdin graft offers the possibility that, even if part of the graft should undergo necrosis, other parts may yet survive so that, as seen in our cases, even though a successful take was not achieved in 100% of these grafts it was the only method of the four herein discussed which could boast 0% failures.

Summary

In The City Hospital of Basle 136 patients representing 156 skin grafts were examined $^1/_2$–$5^1/_2$ years after having undergone operations for either Thiersch, Wolfe-Krause, Reverdin or Crossfinger grafts following fingertip trauma.

The healed grafts were tested for sensitivity to touch, and a survey taken to determine the patients' subjective opinion as to the sensitivity to cold and pain. The files of SUVA were consulted to establish the average duration of treatment, number of work days lost and cost of treatment.

Bibliography

1. T. D. Croman: American surgeon, *17*, 419 (1951).
2. F. P. Ballenger: USA Armed Forces Journal *3*, 561 (1952).
3. B. C. Kilbourne: Industrial Med. & Surg. *21*, No 12 (1952).
4. H. Bruck: Wiener Klin. Wochenschrift *65*, 611 (1953).
5. J. Boehler: Monatsschrift für Unfallheilkunde und Versicherungs-Med. *56*, 277 (1953).
6. J. Riess: Der Chirurg *24*, 468 (1953).
7. G. Ostapowicz: Zentralblatt für Chir. *79*, 1868 (1954).
8. H. May: Arch. Kl. Chir. *274*, 215 (1952/1953).
9. H. May: Arch. Kl. Chir. *273*, 240 (1952/1953).
10. S. Bunnell: Surgery of the Hand, J. B. Lippincott Co. (1956).
11. H. Nigst: Chirurgie in der täglichen Praxis. Hippocrates-Verlag (1958).
12. E. Baur: Helvetica Chirurgica acta *24*, fasc. 2, 93 (1957).
13. S. Bunnell: Surgery in W.W. II, Medical Dept., U.S. Army (1945).